



Future Devices: How Design and Materials Help Meet Emerging Needs and Sustainability Goals

An introduction of our presenters..



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ISAAC PLATTE

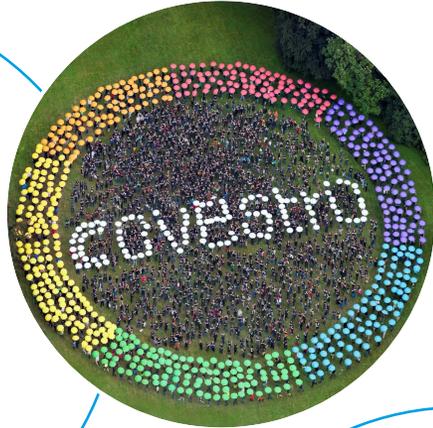
Senior Application Development Engineer

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Covestro – leading in the world of plastics

Strong

- €15.9 bn in sales
- ~17,900 employees¹



Useful

- Plastics, pre-products and solutions
- For many industries



Global

- 50 production sites globally
- Close to customers and partners



Innovative

- ~1,500 employees in research and development
- 80 years of ideas and inventions





You'll find us around the world ... and just around the corner



Covestro worldwide

Covestro counts around 50 production sites in Europe, Asia and America.

Eight of these are equipped with particularly large plants, so called world-scale plants.

~50
production sites worldwide

8
sites with world-scale production plants

10
innovation hubs

Healthcare materials portfolio



Makrolon®

PC

Medical devices, equipment housings



Bayblend®

PC+ABS

Drug delivery devices, equipment housings



Makroblend®

PC+polyester

Durable monitors and pumps, wearable drug delivery housings



Apec®

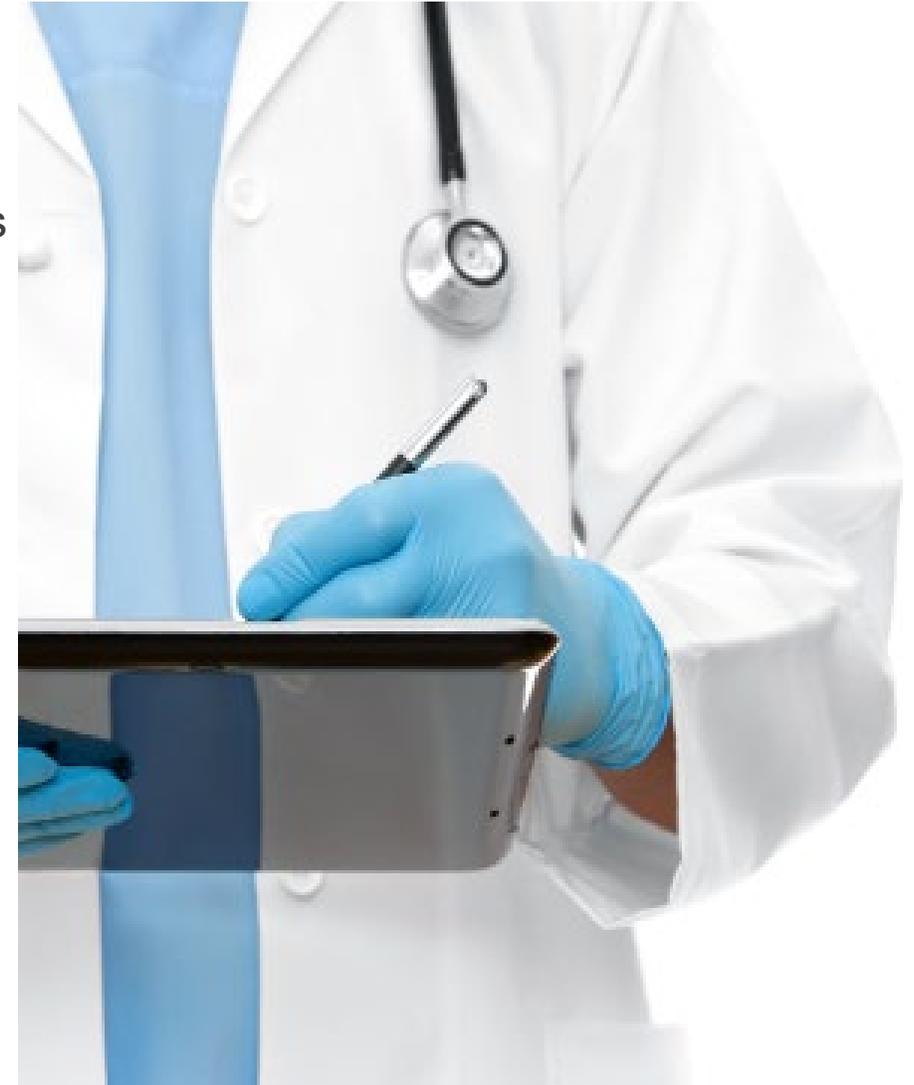
HT-PC

Transparent repeat autoclavability for trays and surgical kits

Covestro medical grades and regulatory compliance



- Biocompatibility: ISO 10993-1 and USP Class VI for contact of 30 days or less
- Compliance to Regulation (EU) 2017/745 on medical devices and (EU) No 722/2012 regarding medical devices manufactured utilizing tissues of animal origin
- Maintenance of FDA Device (MAF) and Drug Master (DMF) File and provide letters of authorization
- Product stewardship
- Manufactured at ISO 9001 certified sites that follow GMP standards
- Supplier notification of change



Covestro drug delivery demonstrator



Developed to demonstrate functionality of an auto-injector

Covestro materials demonstrate functionality of an auto-injector



- High flow Makrolon® PC & Bayblend® PC + ABS
- Low Friction Makrolon® PC
- Low Friction Makrolon® PC
- Medical Glass-Filled Makrolon® PC
- High flow Makrolon® PC & Bayblend® PC + ABS

Covestro materials demonstrate functionality of an auto-injector

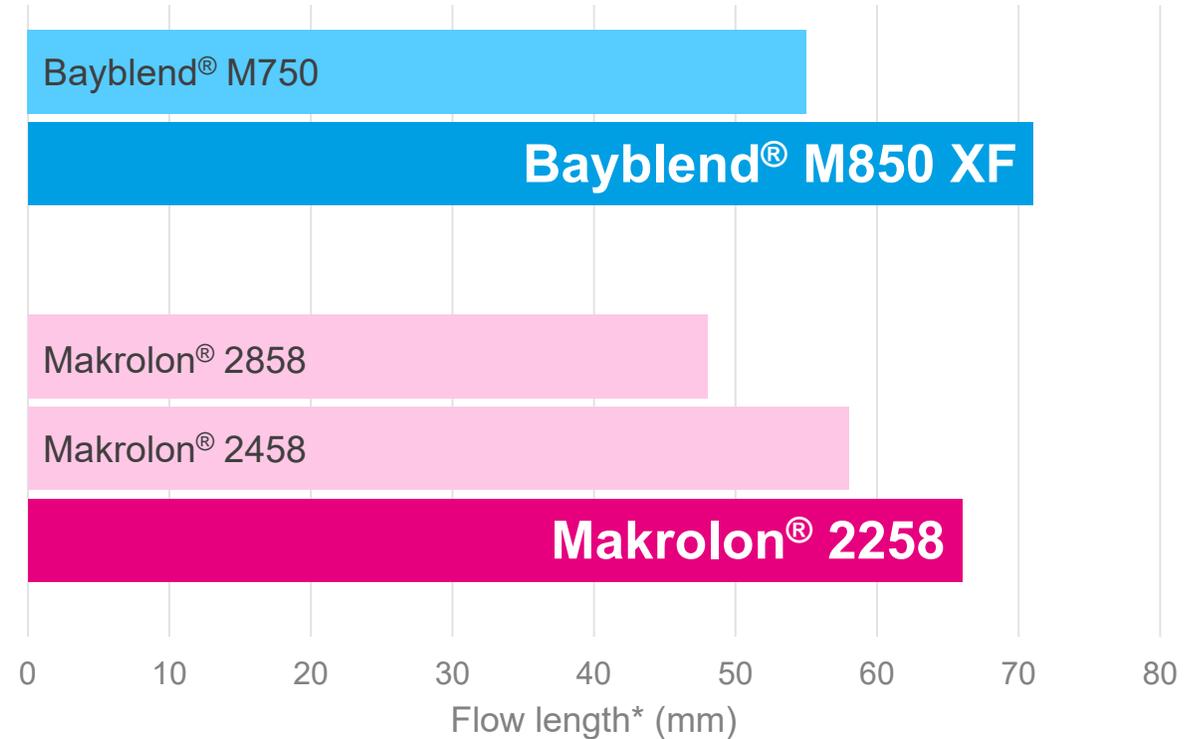


- High flow Makrolon® PC & Bayblend® PC + ABS
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High flow Makrolon® and Bayblend® materials



- Enable thin wall molding to reduce weight
- Maintain toughness
- Transparent and opaque options available to support a variety of designs



For thin wall devices that require toughness

* Flow length for 1mm wall thickness. Conditions used according to datasheet molding recommendations

Covestro materials demonstrate functionality of an auto-injector



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- Low Friction Makrolon[®] PC
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Medical Glass-Filled Makrolon® polycarbonate

a range of options for devices that demand **superior** and **lasting strength**

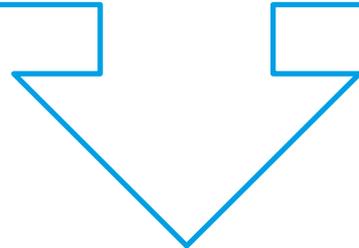


High-flow series

Makrolon® M410 GF

Makrolon® M420 GF

Makrolon® M430 GF



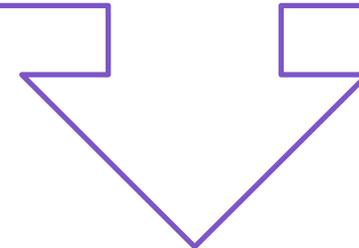
For filling larger or thinner parts

High-performance series

Makrolon® M810 GF

Makrolon® M820 GF

Makrolon® M830 GF

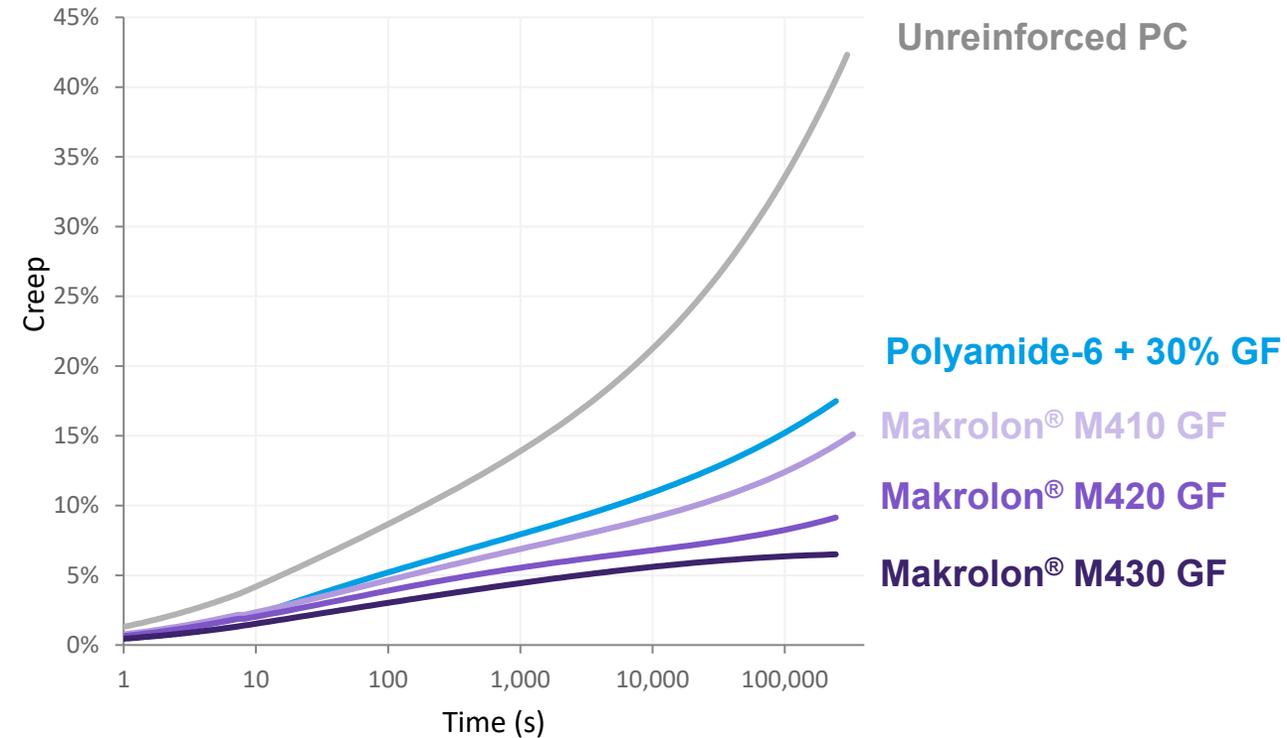


For better impact properties

Medical Glass-Filled Makrolon[®] polycarbonate



- Delivery of high volume and more viscous biologic drugs require different materials
- Stronger components required to maintain dimensional stability under spring load



Improved creep resistance for longer device shelf-life

Covestro materials demonstrate functionality of an auto-injector

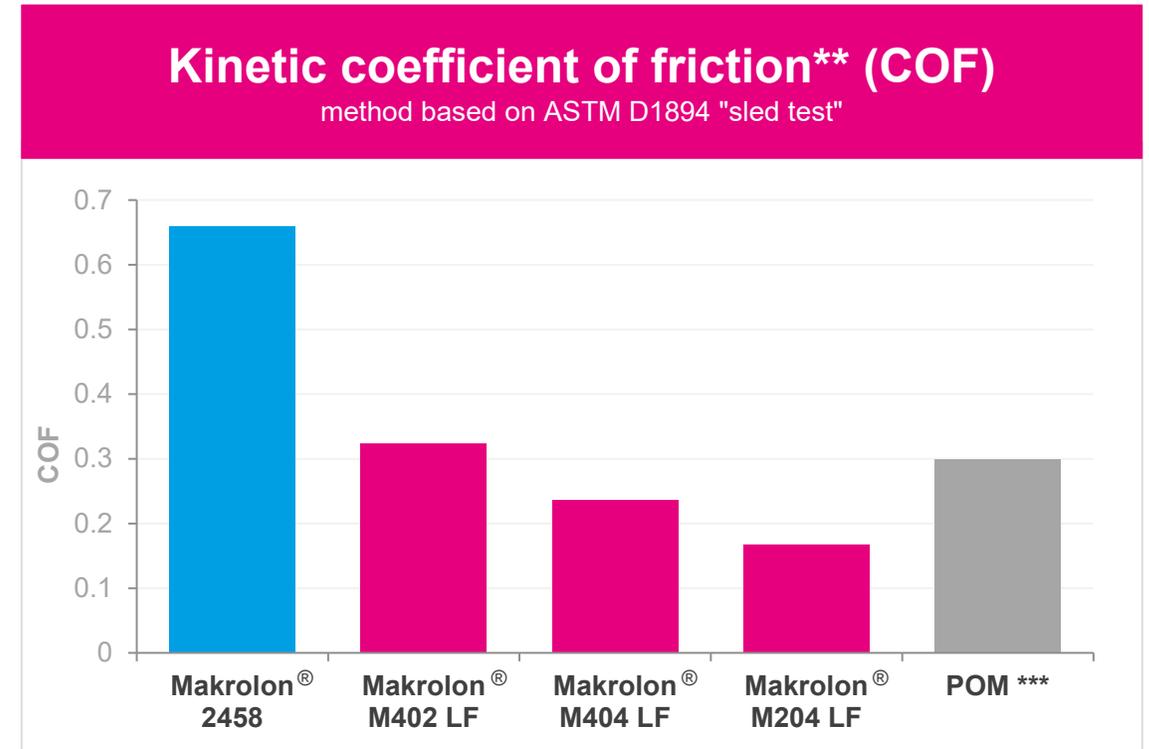


- High flow Makrolon[®] PC & Bayblend[®] PC + ABS
- Low Friction Makrolon[®] PC
- Low Friction Makrolon[®] PC
- Medical Glass-Filled Makrolon[®] PC
- High flow Makrolon[®] PC & Bayblend[®] PC + ABS

Low-Friction Makrolon[®] products can reduce deployment force



- With similar or better COF as POM*
- Reduces inconsistency with:
 - Manual application of a lubricant to devices
 - Including additives at the press



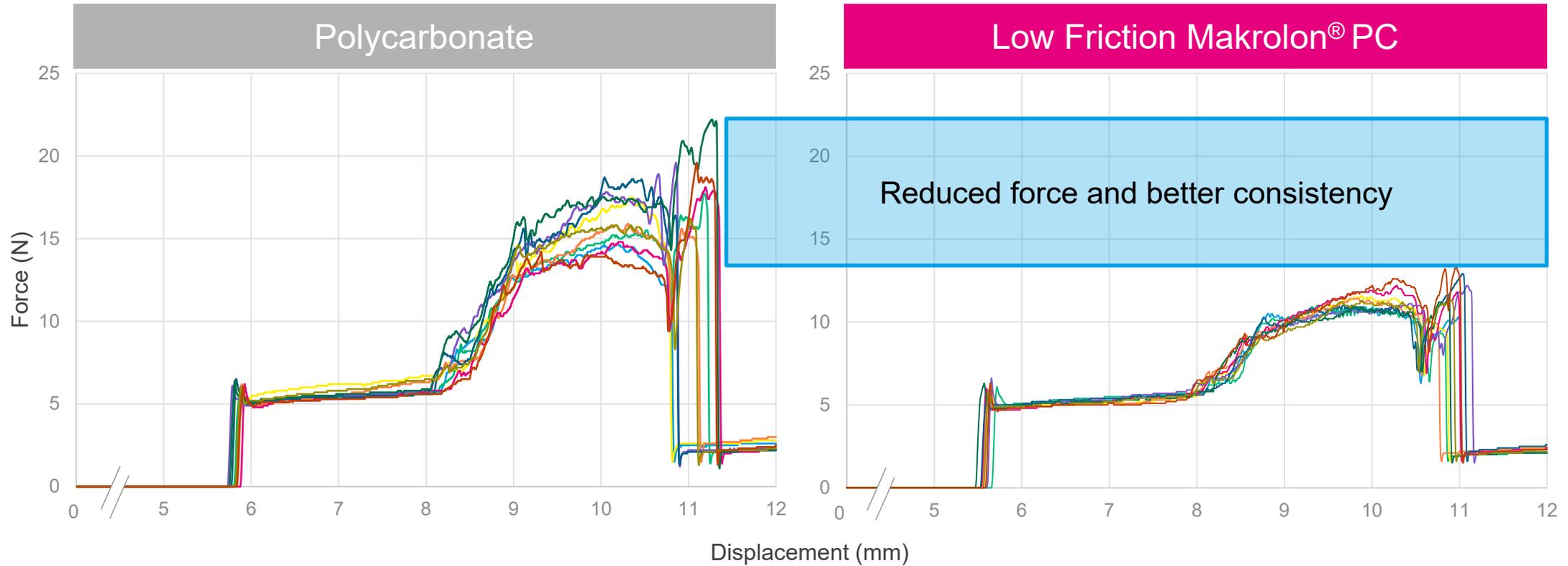
To make medication **delivery easier** for patients and healthcare professionals

* Polyoxymethylene (POM) commonly referred to as acetal

** Self- COF

*** Typical value for POM from supplier datasheets; test methods may differ

Low-Friction Makrolon[®] grade measured in device



Reduces button activation force by 33% and improves consistency by 50%

Covestro materials demonstrate functionality of an auto-injector



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- Low Friction Makrolon[®] PC
- Low Friction Makrolon[®] PC
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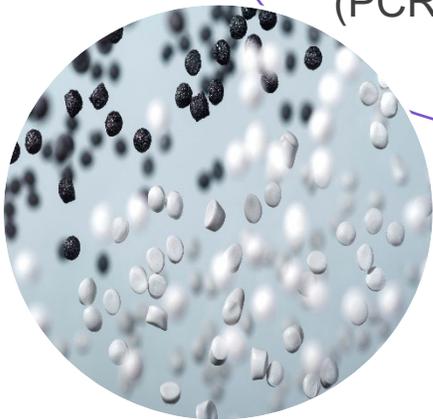
Your go-to partner on sustainability solutions

A sustainable product portfolio with innovative services and solutions



Certified Circular Products

- Drop-in solutions with attributed renewable content- Makrolon® RE PC for Healthcare
- Mechanically recycled (PCR, PIR)



Services

- Design for circularity: Circular Design Strategies
- CMF design service

Enabling circular business models

- Closed/open loop recycling
- Material tracing



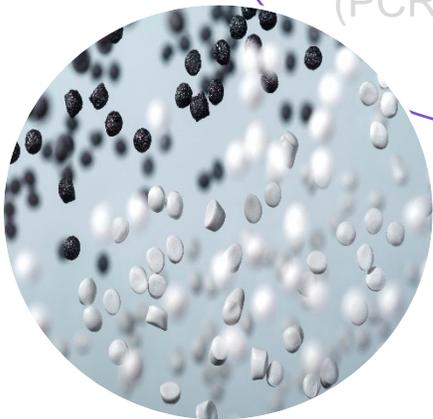
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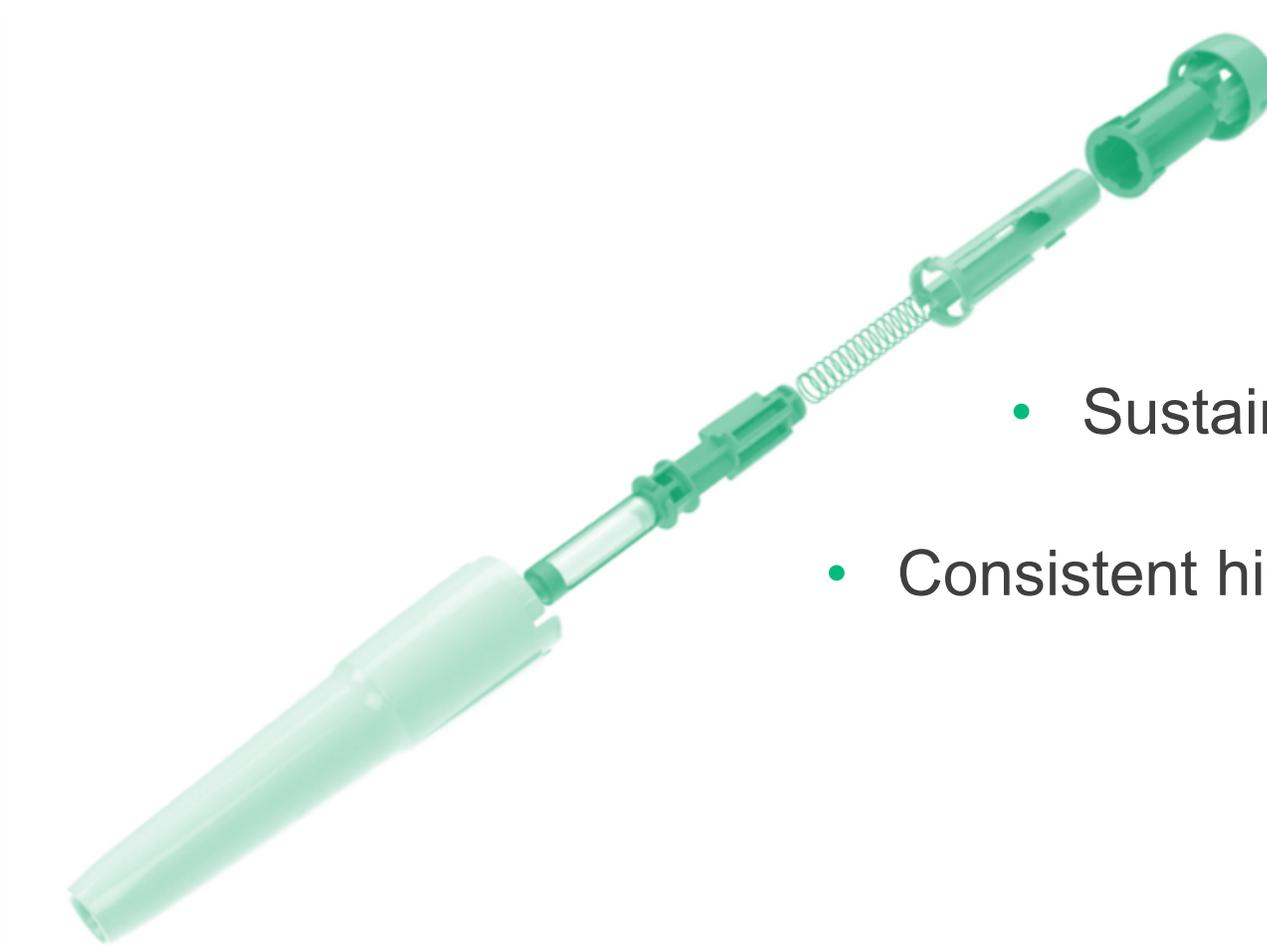
- Services
- Design for circularity: Circular Design Strategies
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- Enabling circular business models
- Closed/open loop recycling
- Material tracing



Medical Makrolon® RE polycarbonate

with attributed renewable content



- Sustainable drop-in solution
- Consistent high quality



Makrolon® RE polycarbonate

The **physical, mechanical, thermal, optical, weathering and processing properties** of Makrolon® RE resins are **identical** to conventional Makrolon® resins and are a **drop-in solution** to meet sustainability goals

Equivalency verified by Covestro



Makrolon® RE resins are **Identical** to conventional Makrolon® resins*

*For example: You can **replace the existing Makrolon® 2458** with Makrolon® 2458 RE*

	Raw Material Specification	Resin Production Process	Product Formulation	Product Specification	Bio-compatibility
Makrolon® 2458	✓	✓	✓	✓	✓
Makrolon® 2458 RE	✓	✓	✓	✓	✓

* Product and quality equivalency confirmed under actual production conditions for representative product

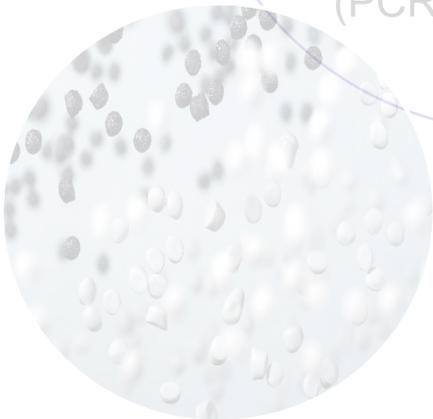
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Services

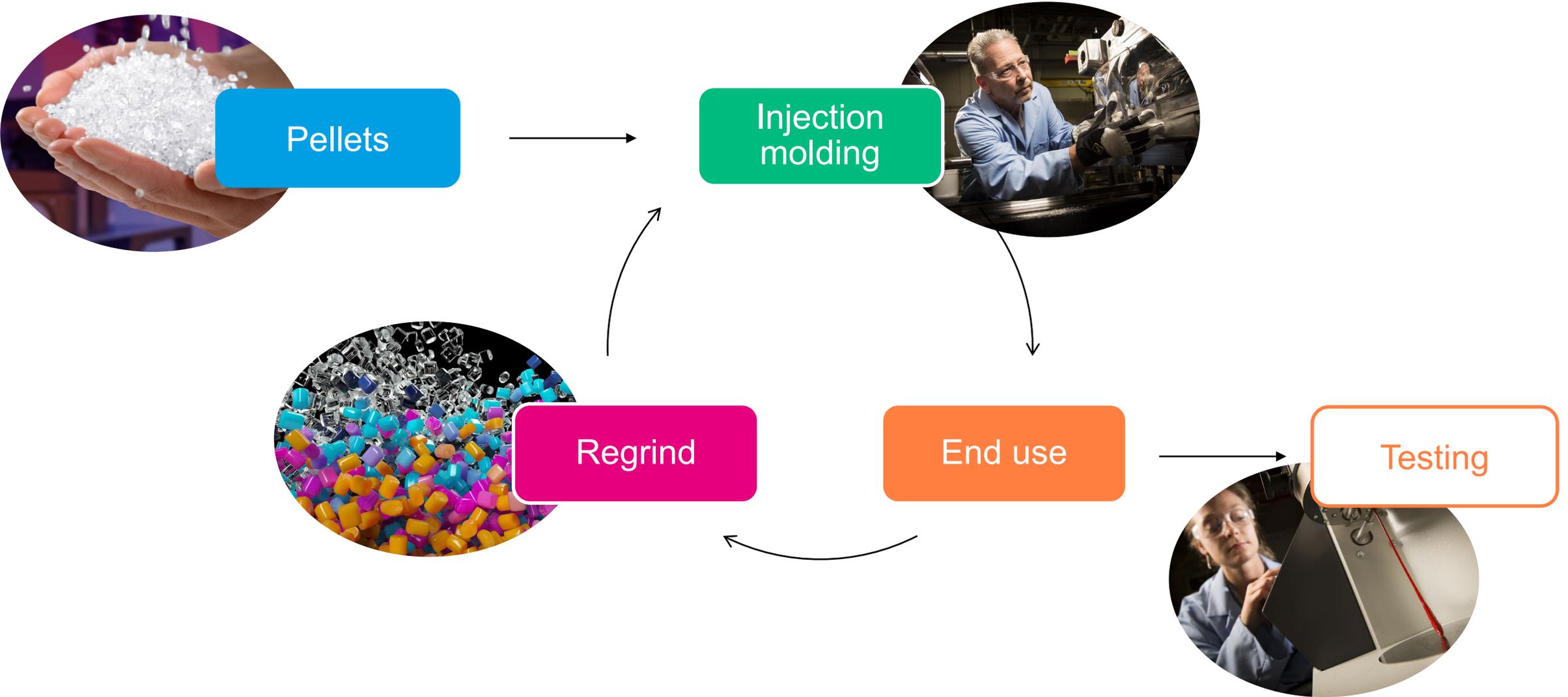
- **Design for circularity:** Circular Design Strategies
- CMF design service

Enabling circular business models

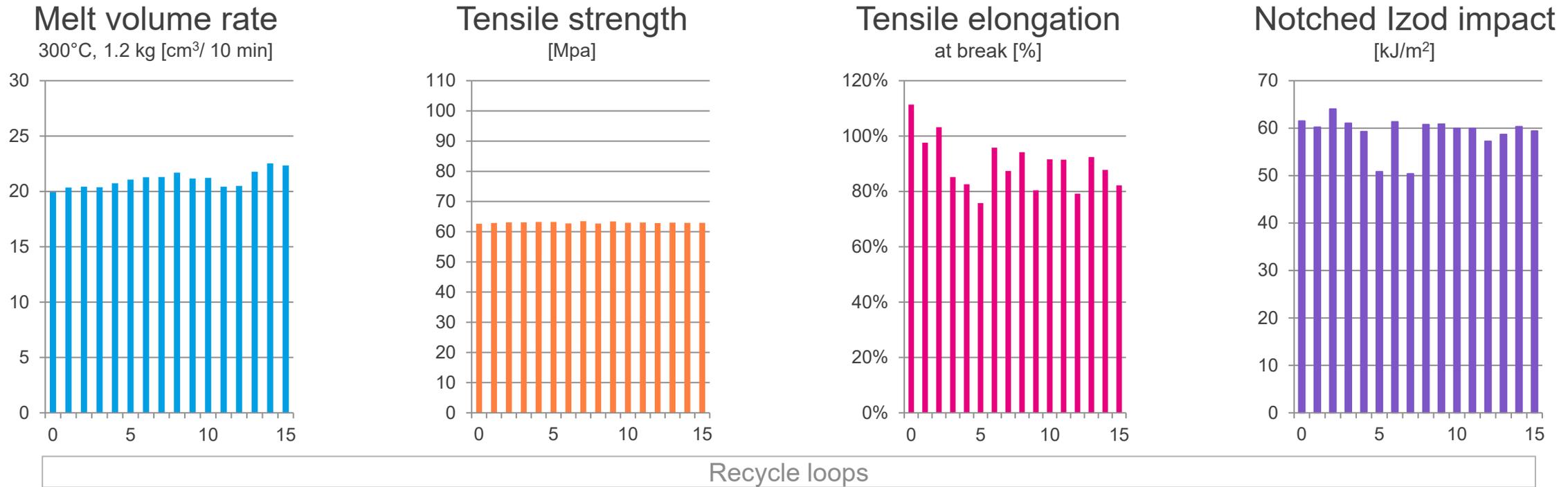
- **Closed/open loop recycling**
- Material tracing



Simulation of closed-loop recycling



Suitability of Makrolon[®] polycarbonate for closed-loop recycling



Tests indicate **100% regrind** retains key mechanical properties over 15 recycle loops

“Unsorted” plastic is the future



Today



A diagram showing an exploded view of a pen. The parts are color-coded: blue (barrel), orange (spring), green (clip), and red (cap). The parts are shown as separate, indicating they are made of incompatible plastics.

- ABS
- POM
- PP
- PC
- PA

✗ INCOMPATIBLE PLASTICS

Future



A diagram showing a pen with a blue barrel and cap, and a red clip. The parts are shown as a single, unified unit, indicating they are made of compatible plastics.

- PC
- PC+ABS
- LF-PC
- GF-PC

✓ COMPATIBLE PLASTICS

“Unsorted” plastic is the future



Today



A collection of various plastic components including a blue cap, a brown screw, a green cap, a brown drill bit, a green cap, and a red pen body.

- ABS
- POM
- PP
- PC
- PA

✗ MUST BE SORTED

Future



A single, re-molded plastic pen with a blue cap and a red body, representing a single material stream.

- PC
- PC+ABS
- LF-PC
- GF-PC

✓ RE-MOLDED AS MIXED OR SORTED



Closed-loop study with “unsorted” PC - based components



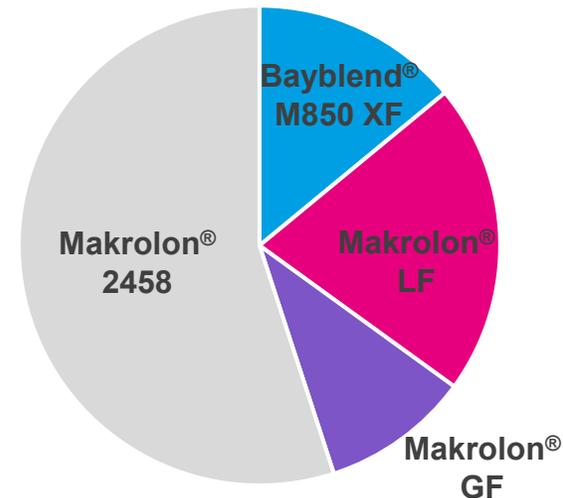
- Body - Medical Makrolon® 2458

- Striker - Medical Glass-filled Makrolon® M430 GF

- Button – Low Friction Medical Makrolon® M204 LF

- Spin wheel - Low Friction Medical Makrolon® M204 LF

- Cap - Medical Bayblend® M850 XF



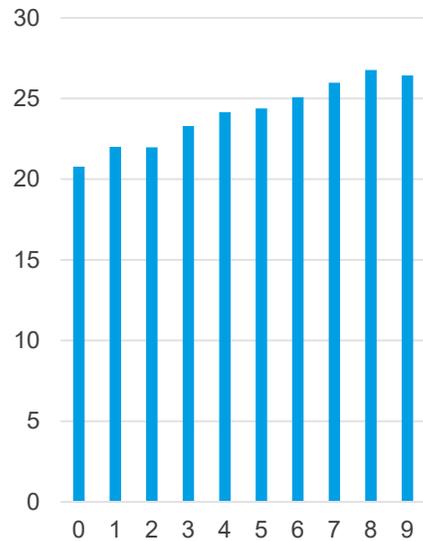
Based on weight percentage



Properties of “unsorted” polycarbonate-based materials

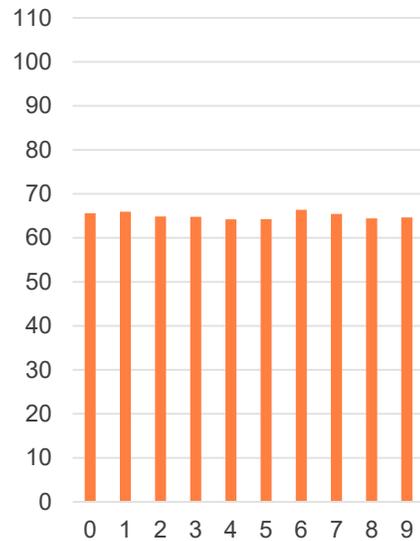
Melt volume rate

300°C, 1.2 kg, [cm³/10 min]



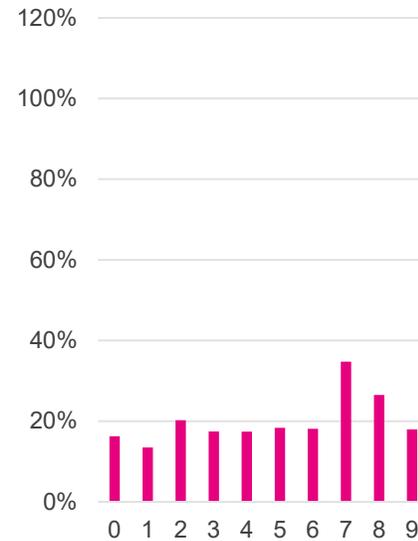
Tensile strength

[Mpa]



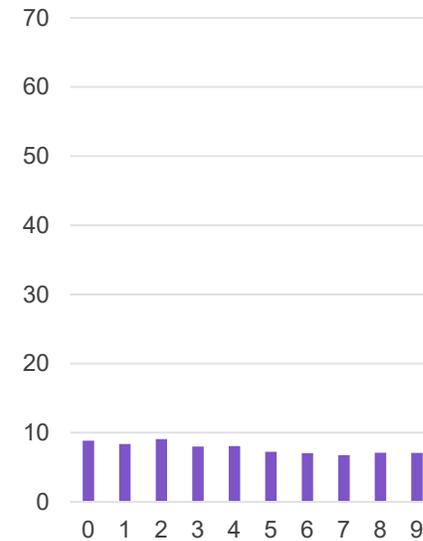
Tensile elongation at break

[%]

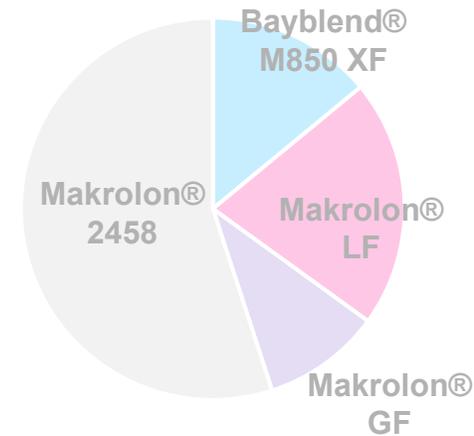


Notched Izod impact

[kJ/m²]

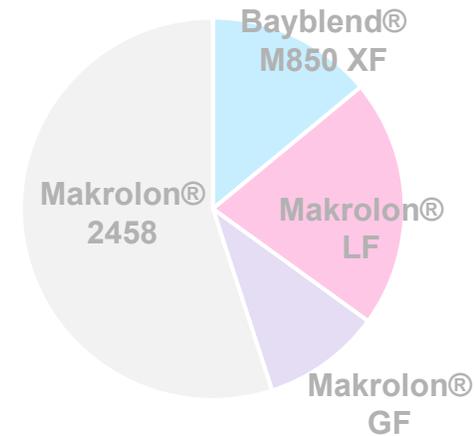
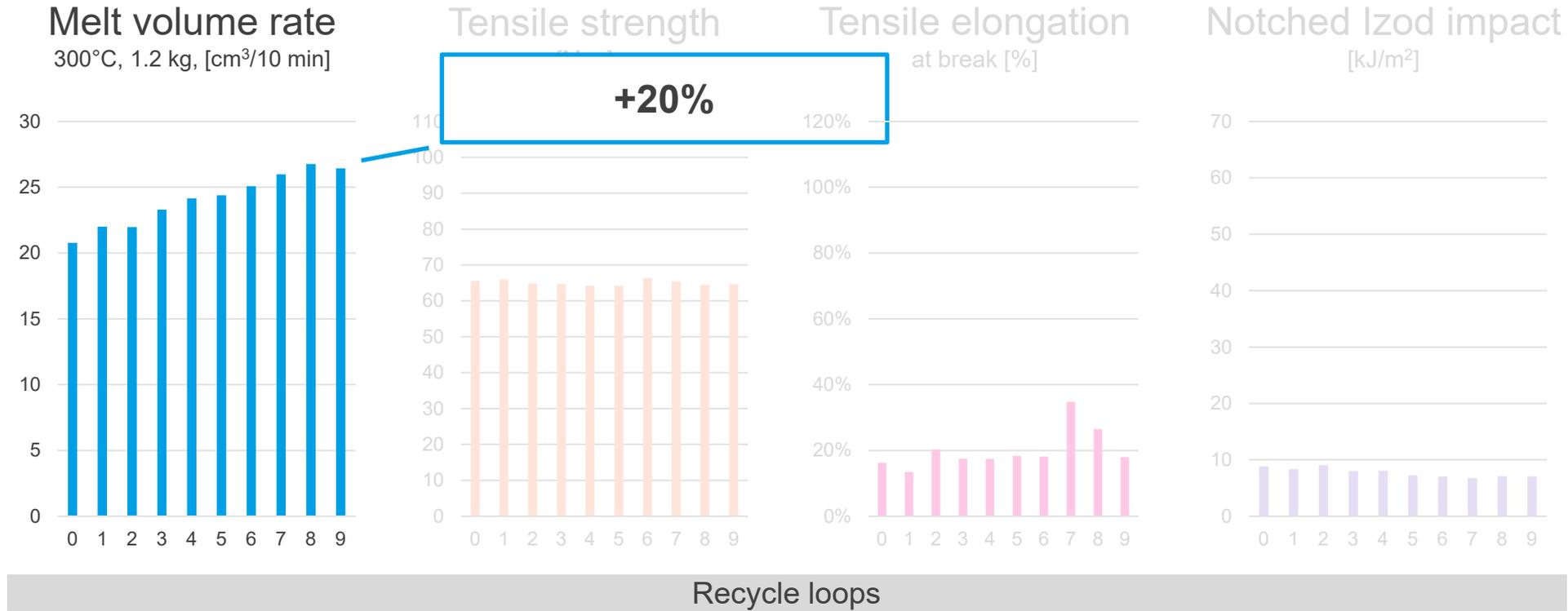


Recycle loops



*study was completed on tensile bars

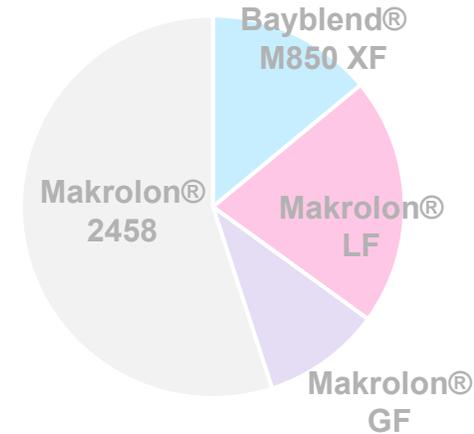
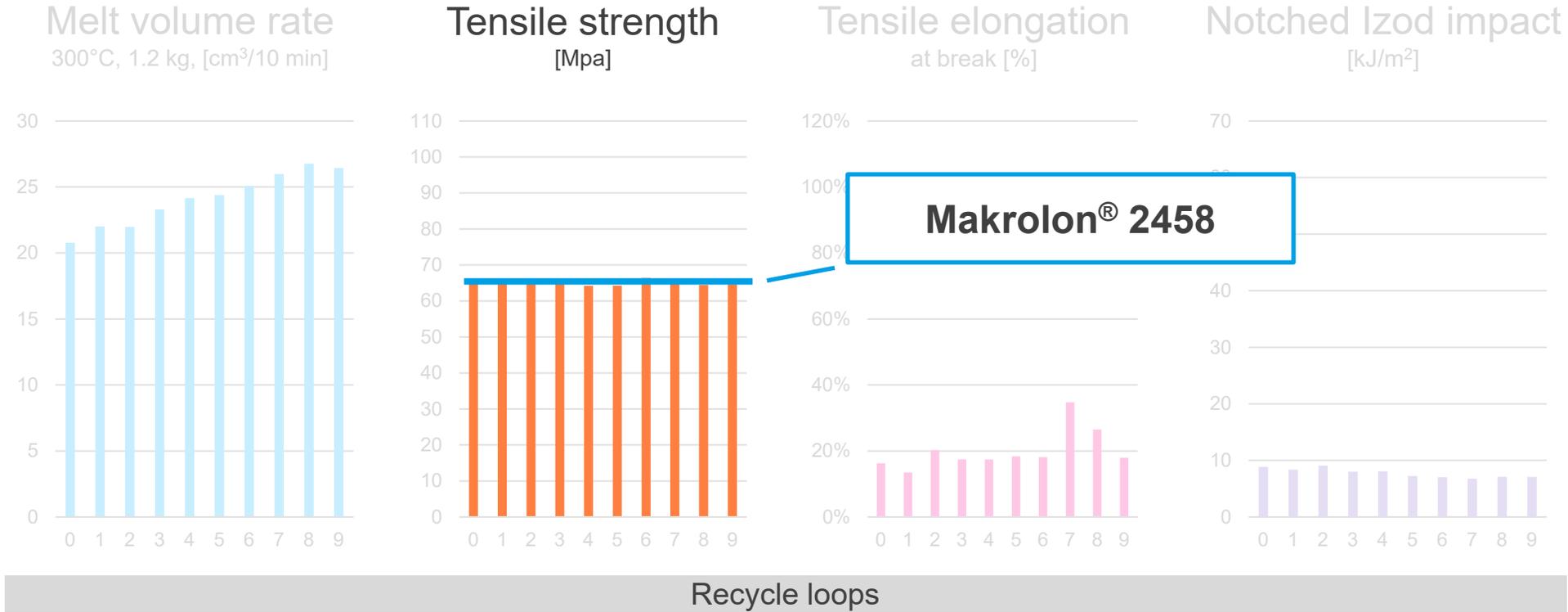
Properties of “unsorted” polycarbonate-based materials



Relatively minor MVR change (20%) allows consistent processability



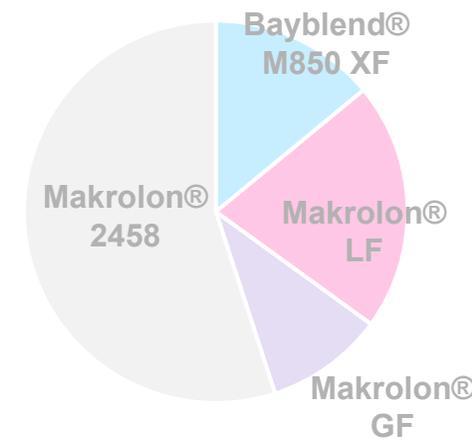
Properties of “unsorted” polycarbonate



Tensile strength comparable to medical Makrolon® 2458



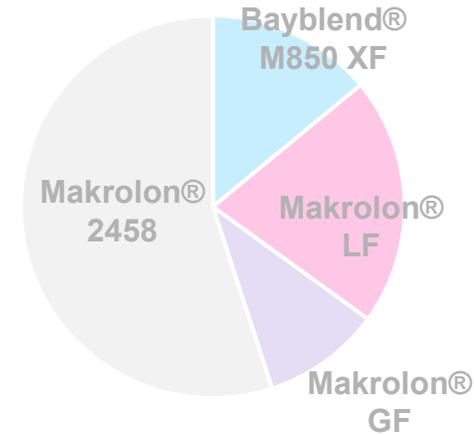
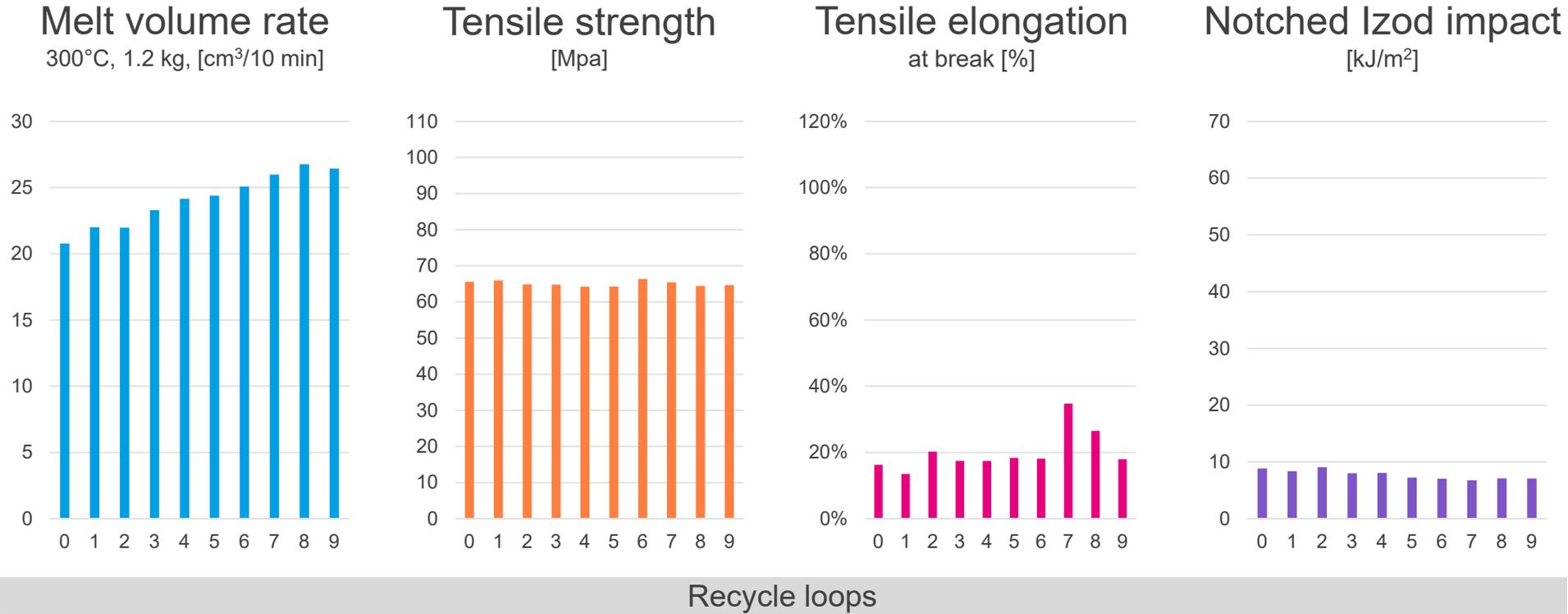
Properties of “unsorted” polycarbonate



Toughness comparable to 10% GF medical Makrolon



Properties of “unsorted” polycarbonate



Consistent properties across recycle loops enables designing for sustainability

Covestro polycarbonates delivering high performing materials enabling sustainable designs



- Material offerings allow for:
 - **Thin-wall** designs
 - Provides **superior** and **lasting strength**
 - **Lower force** and more **consistent** device activation
- Tensile properties, impact strength showed **excellent consistency** across 9 regrind cycles
- Suggests mixing all-PC components could still deliver **consistent** properties for other applications





Thank you!



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